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Reply To: 3420

Date: FEB 23 1990

Subject: Evaluation of root disease centers at Pliocene Ridge
(Rept. No. R90-05)

To: Forest Supervisor, Tahoe National Forest

On January 30, 1990, Forest Pest Management plant pathologist John Kliejunas and entomologist John Dale visited a unit on the Downieville Ranger District with several suspected root disease centers. They were accompanied by district silviculturist Alan Doerr and sale planners Lorie Bell and Karen Walden. The objectives of the evaluation were to identify any root diseases present, and to present pest specific alternatives for use in the silvicultural prescription for a proposed timber sale within the unit.

The proposed timber sale is located within a mixed conifer forest at Pliocene Ridge (T18N, R9E, NE corner of Sec. 1) at an elevation of 4,500 feet. Vegetation consists of 90 to 120 year-old white fir, ponderosa pine, Douglas-fir, incense-cedar, sugar pine, and scattered oaks. Site is Dunning II. Stocking is relatively uniform and dense (320 square feet/acre) throughout. No logging has occurred in the unit since the early 1900's.

Several patches, or pockets, containing windthrown white fir were present. A few dead white fir seedlings and saplings were within these pockets. Characteristic white, laminated decay of Heterobasidion annosum was associated with lower stems and roots of several of the windthrown trees. Small, button-shaped conks of H. annosum were found on one dead white fir seedling. Armillaria decay was common on all of the white fir and some of the pine tissues examined. Although snow cover hindered a complete examination, no evidence of annosus decay or fruiting bodies of the fungus were found on the few old pine or incense-cedar stumps examined.

Evidence suggests that at least some of the white fir windthrow was the result of H. annosum decay, with Armillaria sp. probably playing a secondary role. Apparently only white fir, and not other conifers, is currently affected by annosus root disease in the areas examined.

Environmental and social constraints will likely dictate a shelterwood cut in the sale areas. To reduce the impact of annosus root disease and other pests in the future stand, the following should be considered when developing and implementing the prescription:





1. Discriminate against true firs as leave trees, especially in areas of blowdown.

True firs may be infected with annosus root disease, but not show obvious above-ground symptoms. Such trees are susceptible to windthrow, especially in stands that are opened up. These trees are also less resistant to attacks by *Scolytus* bark beetles. Attacks may kill trees, create top-kill, kill branches, or kill patches of cambium without killing the tree. These "patch attacks" heal over to roughened patches of bark which may serve as attractive focal points for future attacks.

Stand sanitation and measures to keep trees in healthy, vigorous condition are the most practical means for minimizing losses caused by the fir engraver, *Scolytus ventralis*. Stand entries should minimize soil compaction, excess exposure, and other potentially negative impacts on tree and stand vigor.

2. Discriminate against true fir advanced reproduction during site preparation activities.

As above, true fir may be infected with no above-ground symptoms. In addition, true fir would be susceptible to wounding during site preparation. Wounds or mechanical injuries to true firs are especially susceptible to colonization by heart and root rot organisms, including *H. annosum*. Cull resulting from these wounds may average one percent of tree volume each year.

3. Regenerate the site with species resistant to the "S" type of *H. annosum*.

Recent research indicates that *H. annosum* consists of at least two intersterility types, a "P" type and a "S" type. These types, or biological species, are apparently host specific. The "P" type infects pines, western juniper and incense-cedar. The "S" type has been recovered from true firs and giant sequoia. The type on Douglas-fir is unknown.

If only the "S" type of *H. annosum* is present on these sites, pines or incense-cedar should not be infected, even if planted adjacent to infected white fir stumps. Therefore, ponderosa pine can be maintained as a significant component of the stand. Given recent precipitation amounts, current levels of bark beetle-caused mortality indicate that the carrying capacity of the site is high. However, each pine exists at a stocking level determined by its nearest neighbors, not an overall stand average. Stocking levels of tree clusters should be significantly reduced to minimize losses from bark beetles in the near future.

Sugar pine is attacked by pine engravers (*Ips* spp.), red turpentine beetle (*Dendroctonus valens*), and more significantly, the mountain pine beetle (*D. ponderosae*). Attacks generally are scattered and confined to individual trees in a stand such as Pliocene Ridge. Maintenance of tree vigor through regulation of competition is the best preventive measure.





4. Consider the use of borax.

Borax is equally effective in preventing new stump infection in both pines and true fir. From a biological perspective, borax would prevent new infection, and its use on all freshly-cut, commercial size, conifer stumps should be considered. However, with true fir, the current levels of annosus root disease present cannot be determined because infection usually results in heart rot with no above ground crown symptoms produced. Furthermore, borax treatment of true fir stump surfaces will not prevent the entrance of H. annosum into true fir stumps through wounds, nor will it eradicate existing root or stump infections present at the time the tree was cut.

5. Maintain oaks as a stand component.

Armillaria sp. is present in most forests and is usually prevalent where oak is a stand component. Successful infection of oaks is usually related to low tree vigor. Death or decreased vigor of oaks allows the fungus to penetrate, decay tissues, and form rhizomorphs. Oak stumps provide a food base for the fungus which is essential for the production and growth of rhizomorphs through the soil. Therefore, the presence or creation of dead oak root/stumps increases the probability of infection of surrounding conifers by rhizomorphs of the fungus. Stumps and roots infected with Armillaria sp. act as disease centers as long as they provide a suitable food base for the rhizomorphs. Mortality of young conifers may begin four to five years after oaks are killed and may continue for five years or more. Maintaining a mixed species stand that includes oaks will reduce the risk of white fir to white fir spread of annosus root disease by reducing chances of root contacts.

Please direct any questions concerning this report to John Kliejunas (415-705-2571) or John Dale (415-705-2757).

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